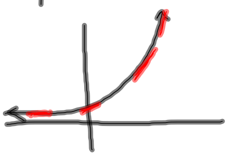
3.9 (a) derivative of exponential functions

$y=e^x$ $\quad e \approx 2.718\ldots \quad \lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x = e$



sketch y'

$y' = e^x$

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$$\boxed{\frac{d}{dx} e^u = \frac{du}{dx} e^u = e^u \frac{du}{dx}}$$

$$\frac{d}{dx} e^{x^2+x} = (2x+1)\, e^{x^2+x}$$

$$\frac{d}{dx} e^{\sqrt{x}} = \frac{1}{2} x^{-\frac{1}{2}} \cdot e^{\sqrt{x}} = \frac{1}{2} \frac{1}{\sqrt{x}} e^{\sqrt{x}}$$

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$$y = e^{3x} \cdot \tan^{-1} x$$

$$y' = e^{3x} \cdot \frac{1}{1+x^2} + \tan^{-1} x \cdot 3e^{3x}$$

middle in

$$y = e^{\sin^{-1}(x^2-1)}$$

out

$$y' = 2x \frac{1}{\sqrt{1-(x^2-1)^2}} \cdot e^{\sin^{-1}(x^2-1)}$$

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Properties: $y=e^x$ & $y=\ln x$ are inverses

$\ln e^x = x \qquad e^{\ln x} = x \qquad \ln e = 1$

$y = 2^x \qquad y = 10^x$

$y' = 2^x \cdot \ln 2 \qquad y' = 10^x \cdot \ln 10$

$$\boxed{\frac{d}{dx}(a^u) = \frac{du}{dx} \cdot a^u \ln a}$$

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$$\frac{d}{dx} 7^{\sec^{-1} x} = \frac{1}{|x|\sqrt{x^2-1}} \cdot 7^{\sec^{-1} x} \cdot \ln 7$$

Ex 2 p 173 $y = 2^t - 3$ at what point does the tan line have a slope of 21?

$\frac{dy}{dx} = 2^t \cdot \ln 2 = 21$ solve for t

$2^t = \frac{21}{\ln 2}$ $\qquad \ln\left(\frac{a}{b}\right) = \ln a - \ln b$

take ln of both sides $\ln 2^t = \ln\left(\frac{21}{\ln 2}\right)$

$$t \cancel{\ln 2} = \frac{\ln 21 - \ln(\ln 2)}{\ln 2}$$

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Exp 1 p 17 $\quad y = 72 - 30(.98)^t$

$$y' = -30(.98)^t \ln(.98)$$

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